DOCUMENT RESUME

ED 061 725 EM 009 710

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TITLE	The Interrelationships of Ability Level, Instructional System, and Skill Acquisition.
INSTITUTION	Human Resources Research Organization, Alexandria, Va.
SPONS AGENCY	Office of the Chief of Research and Development (Army), Washington, D.C.
REPORT NO	PP-29-70
PUB DATE	Sep 70
NOTE	10p.; Paper presented at the American Psychological Association Annual Meeting (Miami Beach, Florida, September 1970)
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	*Ability Grouping; *Achievement; *Aptitude; Educational Programs; *Learning Characteristics; Student Testing; *Teaching Methods

ABSTRACT

The impact of aptitude differences on learning performance is assessed. As a result of the assessment, instructional strategies are being developed to make efficient training programs for men of differing aptitude levels. Observations were that the high level group did better when left without a structured training program. The middle range was also able to work at its own speed but preferred to have authority figure who could answer questions around. The low aptitude groups required a complete structured program in which the instructional sequence is kept down to small steps presented on an elementary language level. (Author/JK)

ED 061725

C.1.v

Professional Paper 29-70
December 1970

The Interrelationships of Ability Level, Instructional System, and Skill Acquisition

by

John E. Taylor, Ernest K. Montague,
and Robert Hauke

Symposium Presentation at the
American Psychological Association
Convention
Miami Beach, Florida September 1970

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EM 009 710

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Published
December 1970
by
HUMAN RESOURCES RESEARCH ORGANIZATION
300 North Washington Street
Alexandria, Virginia 22314

Prefatory Note

This paper was presented at the American Psychological Association Convention Symposium entitled, "The Implications of Aptitude Level and Instructional System for Skill Acquisition and Job Performance," at Miami Beach, Florida. Research for the paper was performed under Work Unit SPECTRUM, Development of Effective Training Across All Aptitude Levels, at the Human Resources Research Organization, Division No. 3, at Presidio of Monterey, California, under Department of the Army contract.

THE INTERRELATIONSHIPS OF ABILITY LEVEL, INSTRUCTIONAL SYSTEM, AND SKILL ACQUISITION

John E. Taylor, Ernest K. Montague,
and Robert Hauke

Work on the interrelationships among aptitude levels, instructional methods and skills to be learned received impetus from the initiation of Project 100,000 and from the recent decision to rescind deferments for graduate students. The Army's training population is large and heterogeneous, spread across a wide spectrum of aptitude, bounded by graduate students at the upper end and by functional illiterates at the lower. Distribution is such that large numbers are found along the entire range. Although technical school courses get only high aptitude trainees, the input to the Army Training Centers reflects the entire aptitude spectrum.

In a three-phased project, we first assessed the impact of these extreme aptitude differences upon learning performance in the current Army Combat Support training, that is, non-combat technical skills; second, we conducted laboratory studies of the effect of extreme aptitude differences in learning a variety of military skills and knowledges; and, third, we undertook the development of instructional strategies for optimizing training efficiency for men of differing levels of aptitude.

Phase 1. During the first phase the impact of these wide aptitude differences was assessed. (1) A team traveled to four geographically separated Army Training Centers to survey current practices and problems in training and the effects of such practices on the learning performance of trainees all along the widened spectrum of aptitude.

Courses of instruction, in which trainees at all aptitude levels were enrolled, were observed for several weeks running. Particular attention was given to:

(1) Characteristics of the trainee population; spread of aptitude and attrition patterns
(2) The operational workings of the training system
(3) Efforts and methods in individualizing instruction to accommodate aptitude differences
(4) The types and processes of student evaluation.

It was found that continued use of the Army's group-paced, lockstep, lecture/demonstration/practice paradigm is inefficient and is placing considerable strain upon the training system. These characteristics of the training system work against the less literate student and make it most difficult to instruct high and low aptitude students at the same time. The highly verbal orientation of training objectives, the preference for platform-centered instruction, and the widespread use of paper/pencil examinations all make it difficult to take a functional and job-related approach to instruction.

It was found, furthermore, that attrition is directly and highly related to AFQT score. Virtually all of the Mental Category I trainees studied passed the first time they took a particular course, whereas half of the low Mental Category IV men required recycling one, two, and sometimes three times.

The present system—that is, group-paced and lockstep—is not optimal for handling trainees of a wide range of abilities. Whereas the high level students are not challenged and are required to spend much more time in training than they need, low ability trainees are not able to cope with the large amounts of verbal-academic content.

There were two major conclusions:

(1) The accomplishment of job-related instruction is being hampered by the use of inadequately stated objectives, by the application of overly verbalized instruction, and by ineffective measurement of student achievement.

(2) Breaking the group-paced instructional lockstep through some system of individualization is indicated if there is to be any hope of adapting instruction to the wide spectrum of aptitude prevailing in the Army's training population.

Phase 2. The research was conducted in a laboratory setting in which experimental control could be maintained over a number of variables. (2) To determine the effects of wide aptitude differences on the acquisition of a variety of military knowledges and skills, a sample of Army recruits was divided into three aptitude groups on the basis of their AFQT scores: high, AFQT 90-99; middle, AFQT 45-55; low, AFQT 10-21. These three groups represented the extreme ends and the middle of the AFQT distribution. Each recruit was trained individually to a performance criterion in differing combinations of a battery of eight tasks representative of Army skill training. Depending upon the task, a variety of media combinations was employed—that is, live instructor, closed circuit TV, simulation—to establish learning conditions and to provide instructional methods which would provide the best possible opportunity to learn.

The results were consistent in demonstrating large differences related to aptitude. As groups, the high aptitude excelled, low aptitude did poorly, and middle aptitude group fell in an intermediate range on all measures. Specifically, low aptitude subjects were slower to respond, required more training time to attain a specified criterion, needed more guidance and repetition of instruction, and were decidedly more variable as a group than the middle and high aptitude subjects. Depending upon the particular task, low aptitude subjects required from two to four times as much training time, from two to five times as many trials to reach criterion, and from two to six times as much prompting as the high aptitude subjects did. The learning performance of the middle aptitude subjects was intermediate between that of the high and low aptitude groups but closer to that of the high aptitude groups.

Based on the findings considered up to this point, we have concluded that the relationship of general aptitude to learning performance is a consistent and powerful one and one which has important implications for the efficient conduct of training. The accomplishment of efficient training for men at all levels of aptitude requires the recognition of individual differences in aptitude and the application of instructional strategies that match these aptitude differences. No one single training strategy, particularly one committed to a group-paced model, can efficiently accommodate the present spectrum of aptitude ranging from high Category I down through low Category IV.

Phase 3. This was the working premise of the third and current phase in which instructional strategies—the proper mix of instructional method variables for particular levels of aptitude and for the various types of skills to be learned, are being developed. The learning tasks employed range from simple verbal and motor procedural tasks (such as wire splicing) up to complex tasks requiring the application of principles (such as using grid coordinates to plot positions on a map).

The instructional variables being employed include three subclasses:

(1) Instructional procedures variables deal with the dynamic processes by which training content is imparted to the student. Examples are rate of presentation, amount of guidance, frequency of repetition, and knowledge of results.

(2) Instructional content variables deal with the structure and organization of the material to be learned. Examples are meaningfulness of content and level of language used, the latter being critical for low aptitude trainees.

(3) Instructional resource variables deal with the availability and employment of instructors with materials such as work-books, models, and training aids, and with physical facilities.

The approach consisted of conducting a series of iterative studies, each one assessing some aspect of the interaction of instructional method, aptitude, and task. As the laboratory vehicle for conducting our studies, we have developed a miniaturized training sequence of several days' duration. The sequence is composed of a variety of learning tasks selected from the high density military occupational specialties which draw trainees from all along the aptitude spectrum. Several levels of complexity are represented.

Values of the instructional method variables and their interaction with aptitude in the learning of the various tasks have been selected and studies. Various modes of presentation and media are being tried out with these selected variables. For example, one study involved a tape/slide program with and without a live instructor using fast and slow rates of presenting. Another study combined the programed text format with differing language levels. Our latest studies have had recruits providing instruction for their peers immediately following completion of their own training.

We are not proposing to study all combinations of media and method variables. Previous research provides considerable guidance, and, further, many combinations do not make practical sense. Thus, we have exercised considerable care in selecting the combinations for study.

To date, we have studied the learning performance of over 350 low, 190 middle, and 180 high aptitude recruits as they underwent training in our miniaturized training sequence. Though total numbers too have been small and analyses too unfinished for conclusions, particular relationships have become clear.

It was found that any strategy will work with high aptitude trainees, but the one which seems to be most efficient and which seems to motivate them most is no structured program at all. They learn most efficiently when left alone. They should be given the instructional objectives, the freedom to choose their own study methods, to schedule themselves, to decide whether to practice or not, to decide whether to work alone or in groups, and to declare when they are ready to be tested. Set the tasks to be mastered before them, give them materials, and then get out of their way. A highly structured program which, in effect, puts them into a lockstep holds them back. The built-in feedback provided by highly structured programs is not required. They provide their own feedback. Further, these individuals are so oriented toward learning and have been so successful in their previous learning experience that motivating them presents little problem.

The middle aptitude trainees have presented much the same picture. Like the highs, they seem not to need to have things structured; they do not need to be "interested" in the formal sense nor do they require built-in feedback. They, too, are able to structure for themselves and to chart their own progress. However, they differ from the highs in that they find the presence of a live monitor to be supportive. They seem to be somewhat less self-assured and independent than the highs, and they appear to learn most efficiently if someone of authority is present of whom they can ask questions. It is as though they need reassurance along the way. In the absence of such a monitor, they turn to one another with their questions. Again, motivation is not a big problem.

The low aptitude soldiers have presented a quite different picture. They require complete structure in which instructional sequences are broken down into small steps, presentation rate is kept slow, repetition rate is high, language level is kept at the most elementary level, and content is presented in a functional context which provides extensive practice. Most importantly, the presence of a live instructor appears to be essential. They require almost constant prompting and feedback. The "instructor" may be a formally designated one; he may be one of their peers temporarily assigned an

instructor role; or he may be one who has emerged from the group to tutor the others. Canned programs alone appear to be insufficient, particularly printed ones. These men have such reading difficulties that even the simplest of programed texts devised, consisting of a few liberally illustrated pages, have not been effective. As for motivation, these individuals are oriented away from learning situations and have long histories of failure in school. Unlike high and middle aptitude men, they have little intrinsic motivation, thus making the provision of meaningful external incentives mandatory.

High variability in performance was found among these low aptitude soldiers, which recently, led to more thorough observations of the role of individual characteristics in their learning performance. We obtained historical material; detailed reading and arithmetical skill measures; measures of visual perception, and visual-motor maturity and skill as reflected in the Bender-Gestalt drawings (3) and the Porteus Mazes; (4) and a measure of social attitudes in the Jesness Social Delinquency Inventory (5). These were chosen from many measures because of the clear and wide differences they showed between Category I and Category IV persons.

Although our number of cases is small, a few conclusions may be drawn. Historical information, gained from the individual regarding home and school history, is so biased toward the "average family" that meaningful relationships are not to be found. More objective information is necessary. We found little relationship between being reared in a family environment, in which a foreign language (usually Spanish) was primary, and classroom ability. We infer in these cases that the AFQT may be falsely lowered and does not reflect actual learning ability. We found in one very small group a depression of AFQT and a marked increase in Bender-Gestalt visual-motor and visual-perception error and difficulty. This group had great all-around difficulty in cognitive and symbolic learning. No measure had much of a relationship with hand tasks such as wire splicing or checking out a switchboard. Correlations between either the AFQT or Bender-Gestalt errors and cognitive tasks were in the 30's, with the visual perception measures being more highly related to such visual-verbal tasks as learning military symbols.

Analysis of arithmetic and reading performance shows clearly that for Category I persons and for the lowest performers there is a unitary complex skill of reading or of arithmetic. In the case of Category I individuals, there is general proficiency in all phases; in the case of the lower Category IV men, general inability in all phases. For the high Category IV, there are clearly a number of functional arithmetical and reading skills, some of which are mastered by a given individual and some of which are not. The implication is very strong that reading and arithmetical skills for these individuals must be geared to the demands of the specific job. Few jobs make all inclusive reading or arithmetical demands.

In general, despite the tentative nature of this study of the individual characteristics of Category IV, it has become more clear that, unitary overall ability is a fiction and that training should be aimed at building the specific skills needed on the job.

To summarize, we have found that aptitude as measured by the AFQT is highly related to learning performance, with high aptitude men out-performing low aptitude men by factors of as high as five and six. The Army's current group-paced, lockstep approach takes too little account of these differences and thus is inefficient. Trainees of the various aptitude levels respond best to dramatically different training strategies with the lowest level requiring considerable close attention if their specific deficiencies are to be remedied.

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Unclassified

Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY *(Corporate author)*
Human Resources Research Organization (HumRRO)
300 North Washington Street
Alexandria, Virginia 22314

2a. REPORT SECURITY CLASSIFICATION
Unclassified

2b. GROUP

3. REPORT TITLE
The Interrelationships of Ability Level, Instructional System, and Skill Acquisition

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Professional Paper

5. AUTHOR(S) *(First name, middle initial, last name)*
John E. Taylor, Ernest K. Montague, and Robert Hauke

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
December 1970	8	5

8a. CONTRACT OR GRANT NO.
DAHC 19-70-C-0012

b. PROJECT NO.
2Q062107A712

c.

d.

9a. ORIGINATOR'S REPORT NUMBER(S)
Professional Paper 29-70

9b. OTHER REPORT NO.(S) *(Any other numbers that may be assigned this report)*

10. DISTRIBUTION STATEMENT
Approved for public release; distribution unlimited.

11. SUPPLEMENTARY NOTES
Presentation at American Psychological Association Convention, Miami Beach, Fla. September 1970. Work Unit SPECTRUM

12. SPONSORING MILITARY ACTIVITY
Office, Chief of Research and Development
Department of the Army
Washington, D.C. 20310

13. ABSTRACT

This paper describes an assessment of the impact of aptitude differences on learning performance. As a result of these tests, instructional strategies are being developed to make efficient training programs for men of differing aptitude levels. Observations were that the high level group did better when left without a structured training program; that the middle range was also able to work at its own speed. Low aptitude groups, however, required a complete structured program in which the instructional sequence is kept down to small steps presented on an elementary language level.

DD FORM 1 NOV 68 1473

Unclassified

Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Ability Grouping						
AFQT						
Aptitudes						
Individual Differences						
Instructional Methods						
Learning Aptitudes						
Testing Methods						
Training Programs						